

A Preliminary Summary Of The September 11, 2012 Las Vegas Valley Heavy Rain And Flash Flood Event

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On the afternoon of September 11, 2012 thunderstorms producing heavy rainfall moved across much of the Las Vegas Valley. Rainfall rates of a half-inch to nearly eight-tenths of an inch in 30 minutes resulted in significant and in some cases devastating flash flooding.

The Set-Up

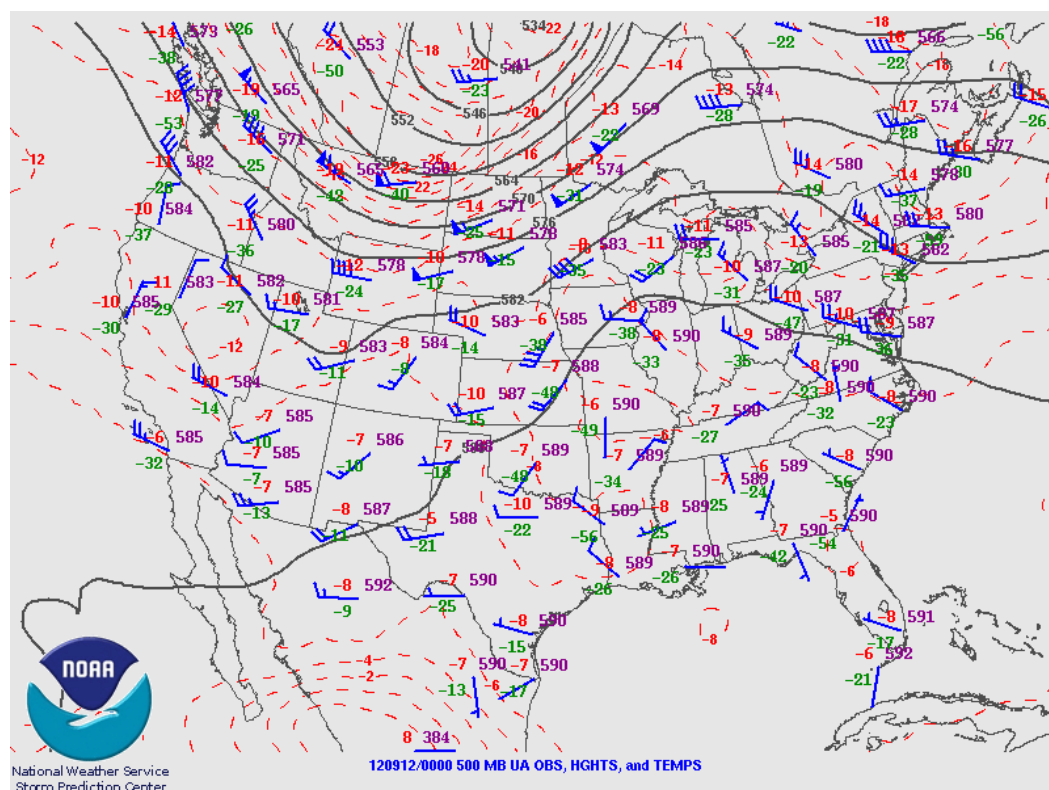
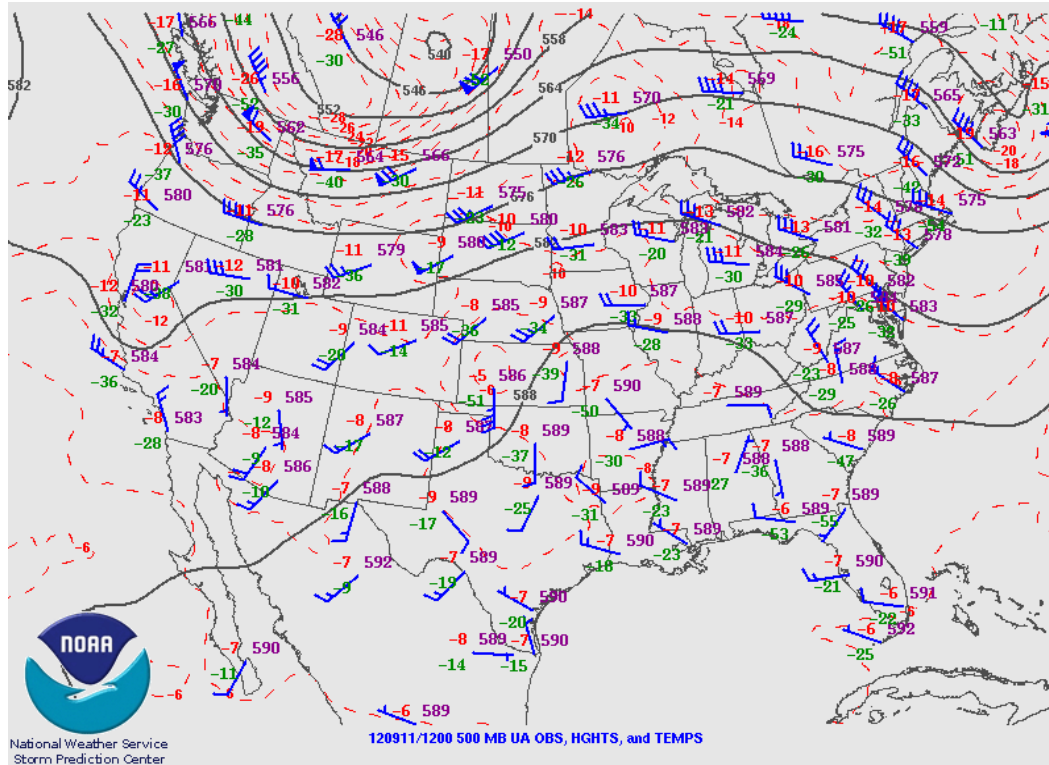
An area of low pressure was noted over central California in the mid and upper levels at 12Z on September 11th. Ahead of this low, exceptionally moist and unstable air existed over the Mojave Desert and southern Great Basin. The 12Z radiosonde launched from Las Vegas measured a precipitable water value of 1.37 inches and an 850 mb dewpoint of 11 degrees Celsius indicative of an extremely moist air mass. Precipitable water values over an inch and 850 dewpoints at or above 8 degrees Celsius are usually indicative of an atmosphere conducive to flash flooding in the Mojave Desert based on local rules of thumb. The combination of the enhanced lift from the low and a very moist atmosphere produced a set-up favorable for thunderstorms producing heavy rain. The low moved across southern Nevada between 19Z and 23Z with showers and thunderstorms ahead of it.

What Happened

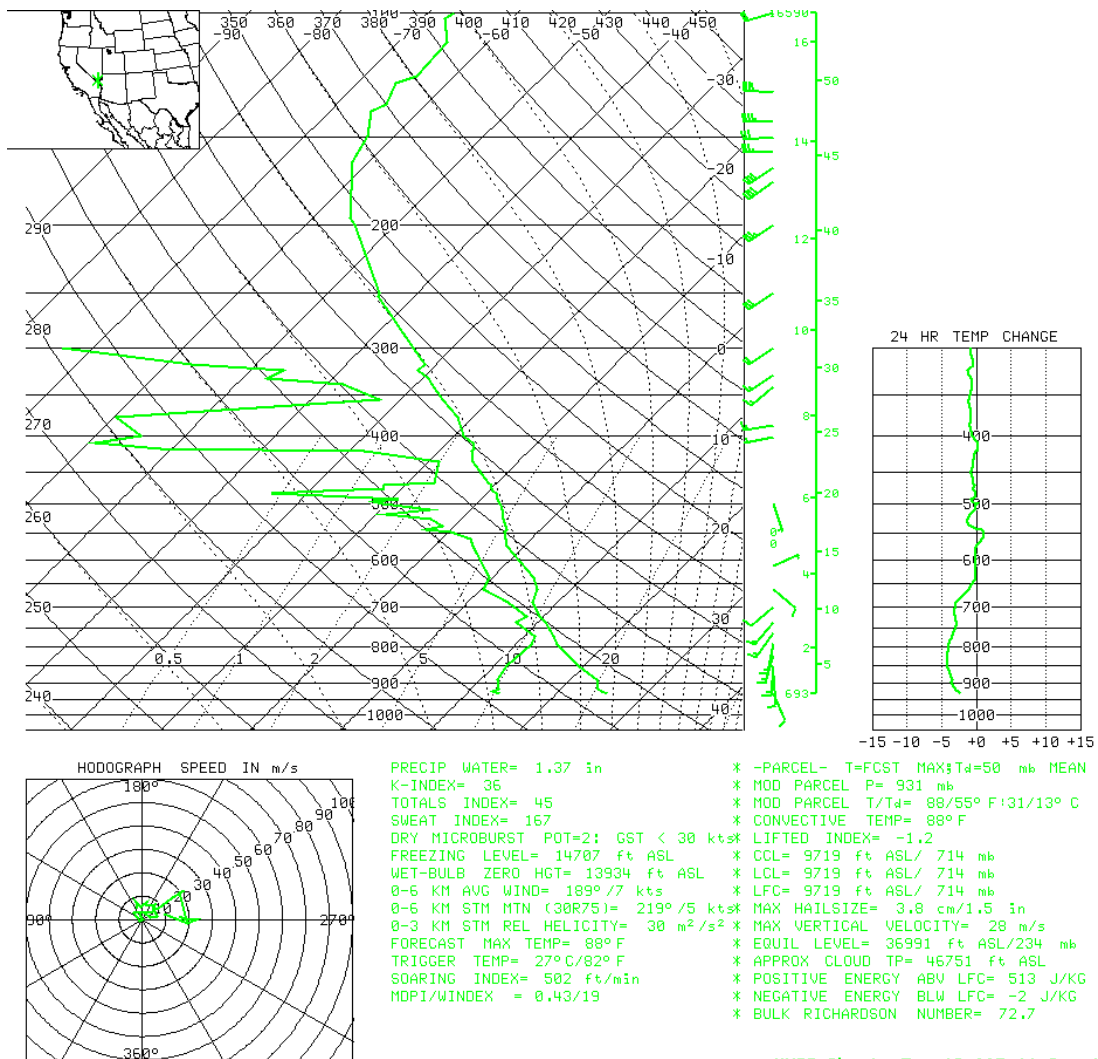
Showers and thunderstorms began to develop during the late morning hours over the Spring Mountains to the west of Las Vegas in an area where surface moisture convergence and mixing ratios were greatest. Thunderstorms over the Spring Mountains became more intense by 12:30 PM PDT as they started to approach the western foothills of the Las Vegas Valley. Around 1:00 PM PDT , one thunderstorm moved east toward the Lone Mountain area while a second moved across the far southwest part of the Las Vegas Valley roughly near Blue Diamond Road. Although the storm near Lone Mountain lost some intensity as it moved east, the storm over the far southern end of the valley maintained its intensity as it approached the center of the valley. As the initial line of thunderstorms crossed the northern portion of the Las Vegas Valley, it intensified as it crossed the area near Jones Boulevard. As the thunderstorms continued to cross the Las Vegas Valley, they developed into a more continuous line by 1:30

PM PDT with 0.5 degree reflectivity values on the Las Vegas WSR-88D radar showing at least 40dBZ along the entire length of the line and numerous areas over 50dBZ. The line of thunderstorms maintained this intensity as it moved further east across the valley. Mesoanalysis data obtained from the Storm Prediction Center showed an increase in the amount of instability and amount of available potential energy for thunderstorm development or CAPE over the eastern and southern half of the Las Vegas Valley. Lifted Index values, a measure of instability, were at least -4 over this area while CAPE values were at or well above 1000 J/Kg. This indicates thunderstorms had a very primed environment to move into and intensify. The highest reflectivity values were reached over Henderson where values in some areas exceeded 60 dBZ. As this line of higher reflectivity values moved across, it produced the majority of the rain that occurred during this event. By 3:00 PM PDT, the main line of thunderstorms had moved across the Las Vegas Valley and the heaviest rain generally ended. However, some additional rain did fall over the next two hours as showers and isolated thunderstorms moved through producing light to moderate rainfall. Rainfall ended by 4:30 PM PDT in all areas.

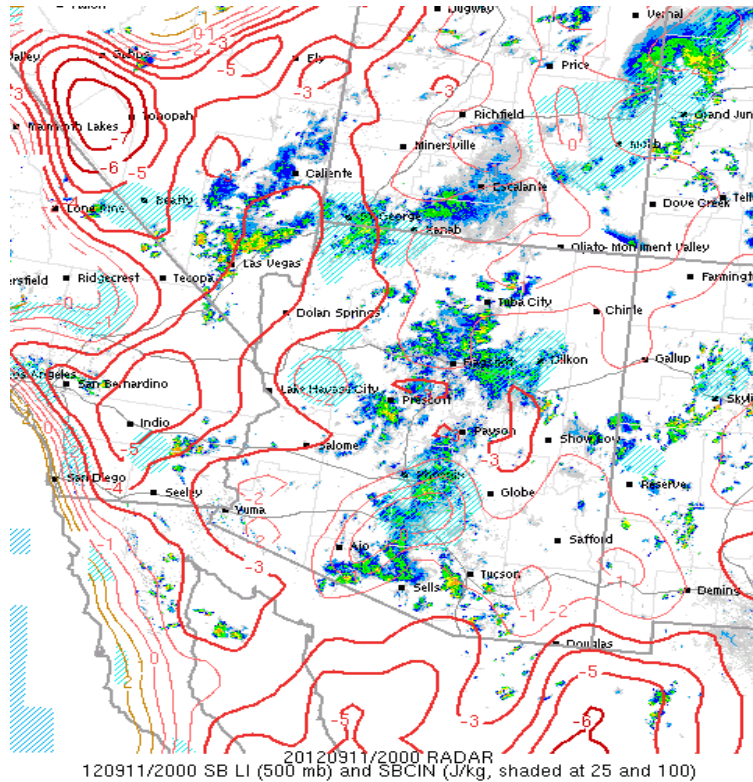
Cross sections of radar showed in general that the greatest reflectivity values were mainly centered at 5,000 feet even in cases where thunderstorm tops built to nearly 30,000 feet. This resulted in an environment where warm rain processes dominated and heavy rain fell from thunderstorms. The Specific Differential Phase (KDP) on the Las Vegas WSR-88D showed values at or above 1 deg/km in several areas across the central and southeast part of the Las Vegas Valley, especially over southeast Henderson where KDP values exceeded 6 deg/km in a small area. With KDP, higher values indicate a greater possibility that heavy rain is falling over a given area.



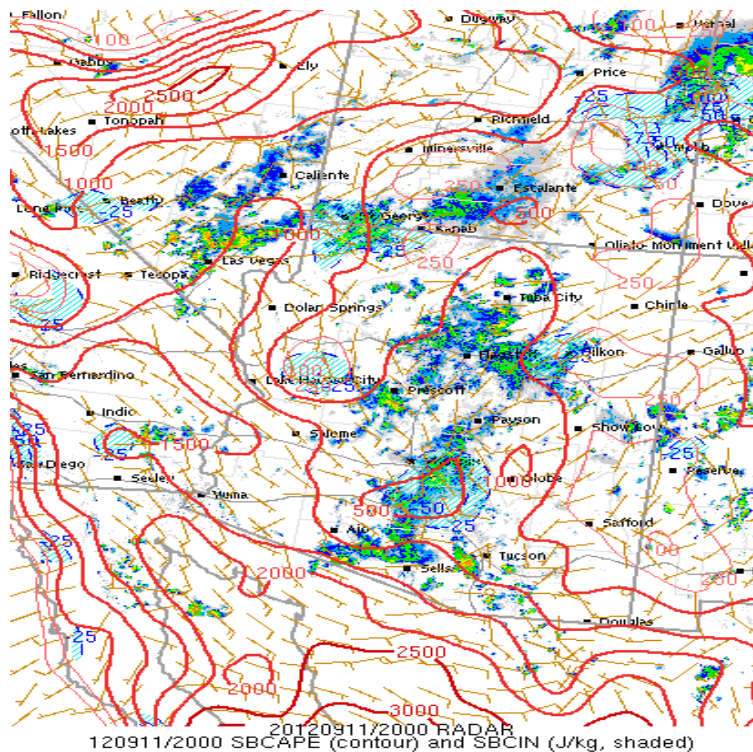
Upper air charts showing the observed values at 500 mb at 12Z on September 11, 2012 (top) and 00Z on September 12, 2012 (bottom). Blue wind barbs can be noted on both maps while solid black lines indicate height lines. Maps courtesy Storm Prediction Center.



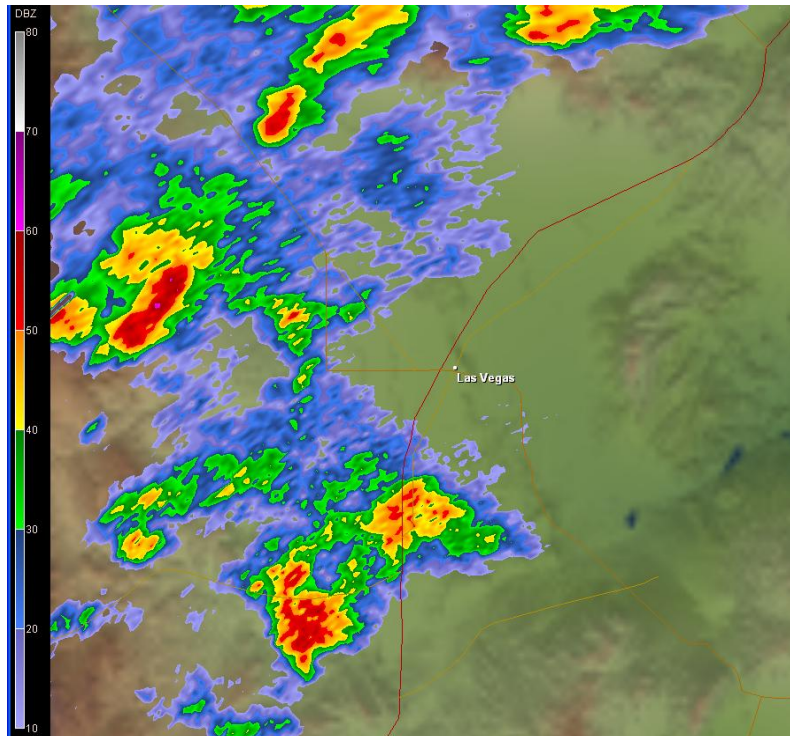
KVFF Skewt Tue 12:00Z 11-Sep-12
 12Z sounding from Las Vegas, Nevada on September 11, 2012.



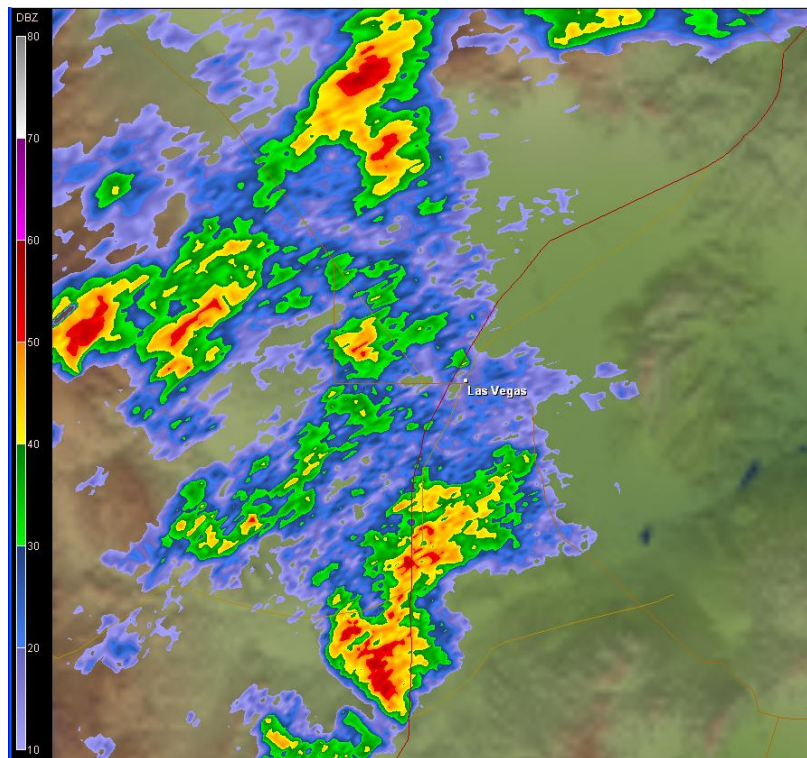
Surface based lifted indices from 20Z September 11, 2012 from the Storm Prediction Center indicated in the red lines overlaid on radar. Note the area of -4 at the time over the eastern side of the Las Vegas Valley.



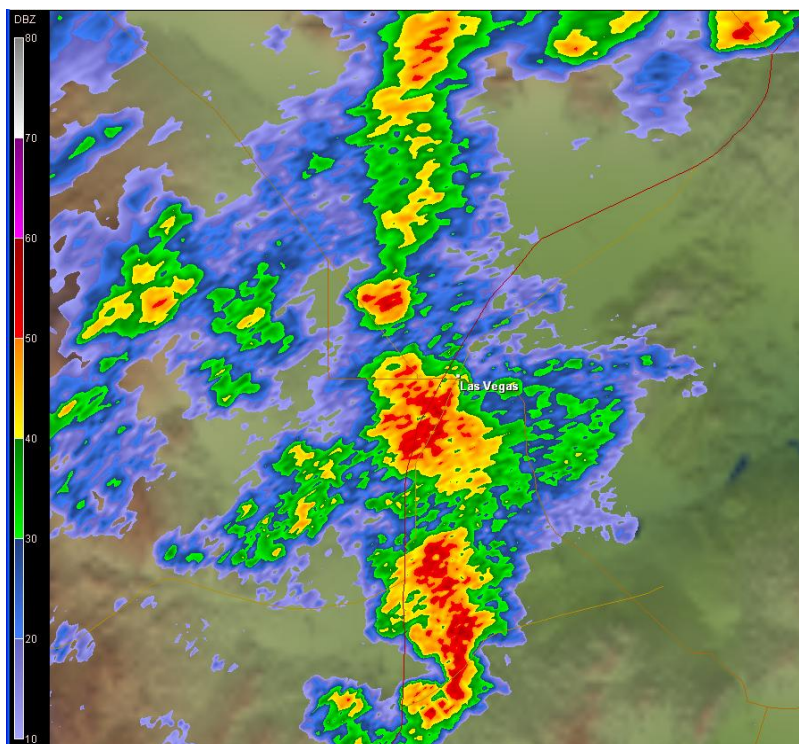
Surface based CAPE from 20Z September 11, 2012 from the Storm Prediction Center indicated in the red lines overlaid on radar.



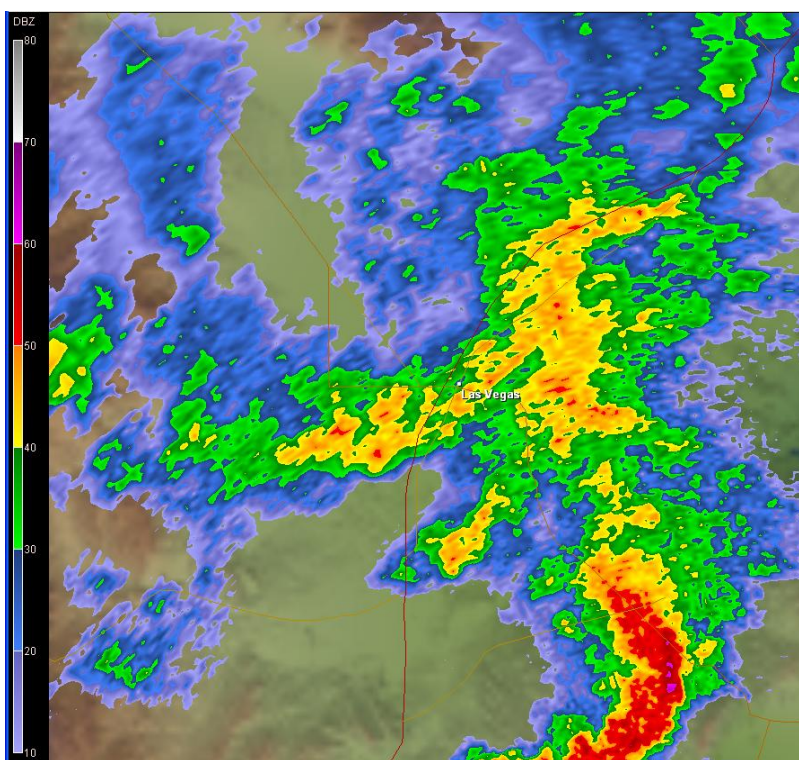
KESX 0.5 degree radar reflectivity at 2005Z on September 11th. Note the brighter colors over the western half of the Las Vegas Valley where heavier rain was falling near Lone Mountain and in the southwest.



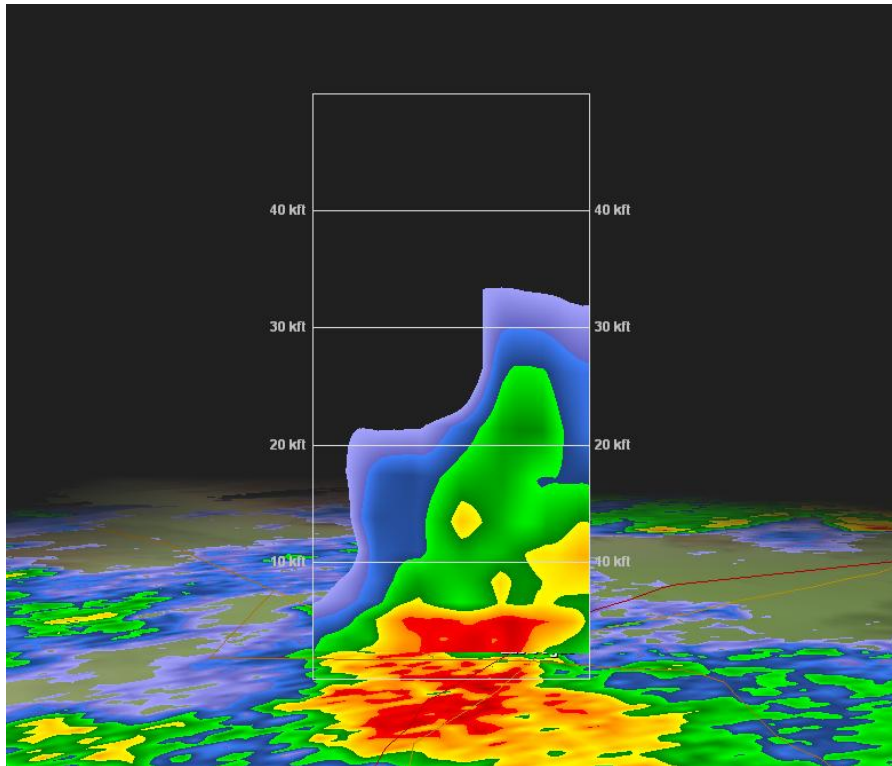
KESX 0.5 degree radar reflectivity at 2017Z on September 11th as thunderstorms started to move east across the valley.



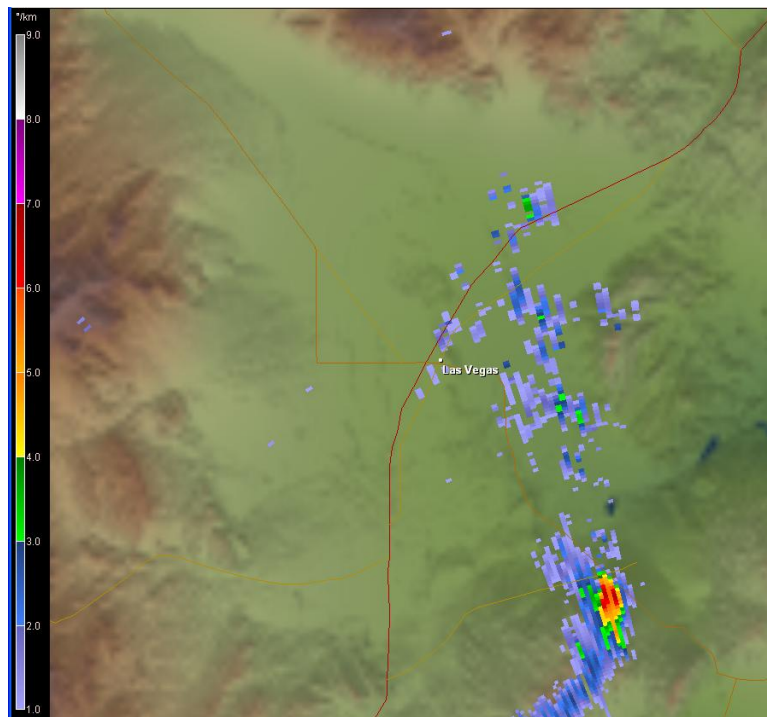
KESX 0.5 degree radar reflectivity at 2030Z on September 11th. Note the brighter colors over the center of the Las Vegas Valley and how a line of thunderstorms had started to form.



KESX 0.5 degree radar reflectivity at 2105Z on September 11th. Note the brighter colors over the eastern half of the Las Vegas Valley especially the southeast part.



Cross section of a thunderstorm over the center of the Las Vegas Valley just southwest of downtown Las Vegas near 2030Z on September 11th. Note the greatest reflectivities were around 5,000 feet even though the top of the thunderstorm reached to nearly 32,000.



KDP values from the Las Vegas weather radar at 21:01Z on September 11th. Note the area of bright colors over the southeast part of Las Vegas where values approached 6 deg/km. Values below 1.0 deg/km are not shown.

Impacts

According to local media reports, at least 50 vehicle rescues took place throughout the Las Vegas Valley by Clark County Firefighters. 40 of these were swiftwater rescues. The largest number of rescues was 15 near the intersection of Sloan and Sahara with one rescue done by helicopter. Roadway flooding was extensive with several inches to several feet of flowing water reported on many roads especially in the central and eastern parts of the Las Vegas Valley. Interstate 215 was closed from Interstate 15 to Eastern Avenue after intense rainfall washed large amounts of mud and rocks onto the highway from nearby landscaping along the side of the road. This also resulted in the Airport Connector to McCarran International Airport being closed. The Charleston Underpass flooded for the first time since extensive construction work was done to mitigate this once flood-prone area back in the mid-2000s. Several inches of water also collected on the northbound off-ramp from Interstate 15 to Highway 95 known as the 'Spaghetti Bowl' resulting in Nevada Highway Patrol detouring traffic to one lane for the evening rush hour. This resulted in extensive back-ups on northbound Interstate 15 of at least 3 miles.

Flooding was also extensive on the campus of the University of Nevada Las Vegas. Floodwaters entered the TBE Building and also flooded portions of a parking lot south of the Thomas and Mack Center where at least two dozen cars were submerged. Floodwaters also entered a nearby shopping center on Maryland Parkway damaging 10 businesses. Some businesses reported a total loss with damage to furniture and equipment. Water also entered the MGM Grand Garden Arena with about two inches of water collecting in some areas.

In downtown Las Vegas, heavy rain caused the roof of a business to cave in near Bruce and Fremont Street. In addition, rain leaked through the roof of the Clark County Regional Justice Center causing flooding. Two machines used to scan people were damaged as well as several security cameras.

The worst impacted area though was near the Desert Rose Golf Course. At least 45 homes were flooded mainly on and near Walton Heath Avenue. Most of these homes suffered extensive damage to their lowest level with many people losing furniture and appliances. In some cases the force of floodwaters busted through concrete walls. Numerous vehicles in this area were flooded and some were floated 300 to 400 feet. Three dogs drowned to death that lived in one house. In addition, a worker at the Desert Rose Golf Course was swept away by the floodwaters from his tractor around 4:22 PM PDT on September 11th. His body was found dead two days later about two and a half miles away.

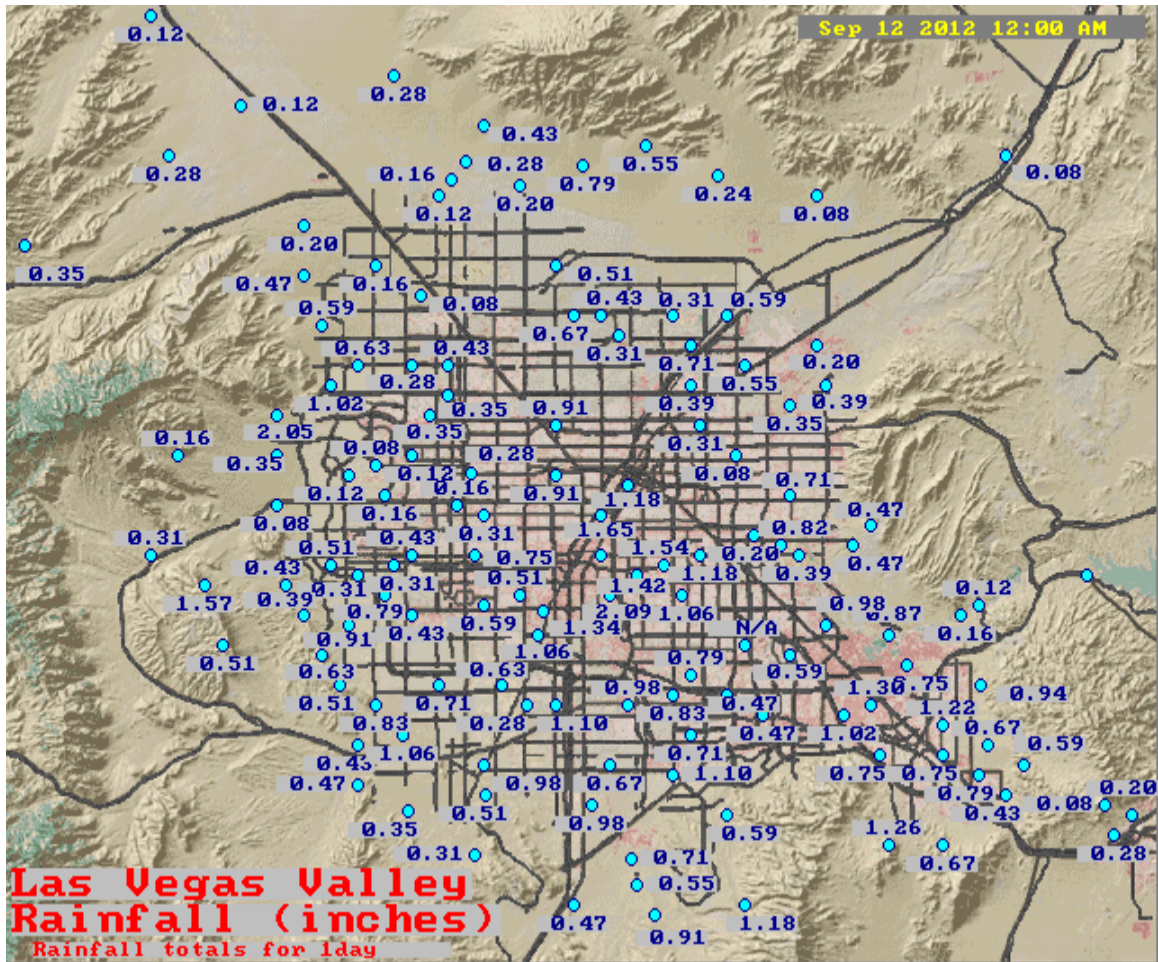
Several other condominiums were flooded in the eastern part of Las Vegas after floodwaters busted through a concrete wall. Arrival flights at McCarran International Airport had delays of up to one hour and forty-six minutes according to the FAA.

Rainfall Totals

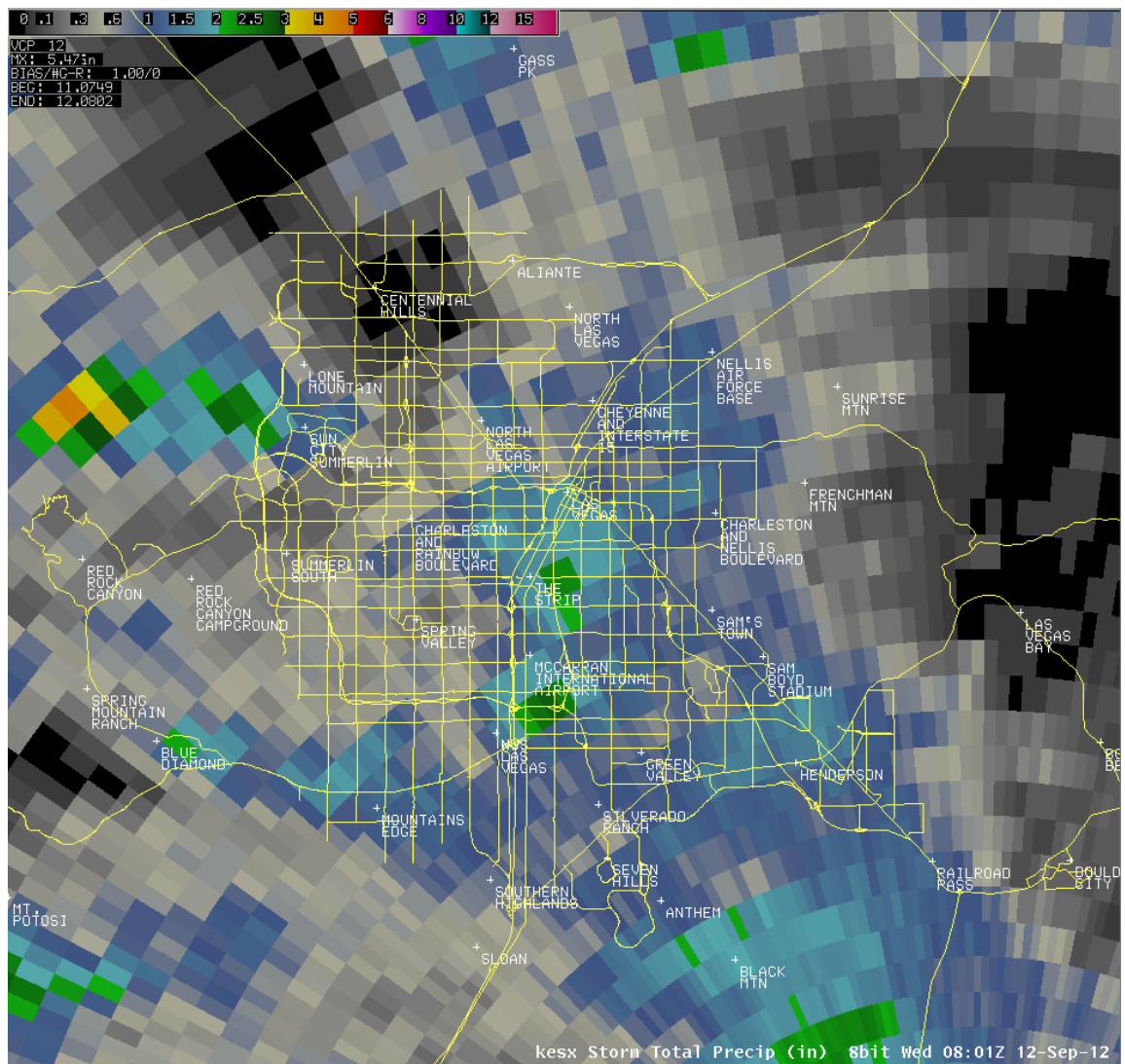
The official long term climate station for Las Vegas is located at McCarran International Airport on the southwest side of the airport complex. A total of 1.18 inches of rain was measured by the automated weather station at McCarran International Airport. This set an all-time record for a calendar day for the month of September breaking the old record of 1.09 inches recorded on September 25, 1939. This marked only the third time in September that an inch or more of rain has fallen at the official Las Vegas climate station since records started in 1937. In addition, the total of 1.18 inches also set a new record for a 24 hour period for precipitation for the month of September breaking the previous record of 1.12 inches that fell from September 25th through September 26th in 1939.

Automated weather stations operated by the Clark County Regional Flood Control District as well as Mesonet weather stations, cooperative observers and spotter reports showed the heaviest rain fell in several areas. 1 to 2 inches of rain fell in northern portions of Summerlin, in and just south of downtown Las Vegas, along Flamingo Road and Tropicana Avenue from near Interstate 15 to near Mojave Road and in southeast Henderson. The highest total reported was 2.09 inches at an automated station operated by the Clark County Regional Flood Control District near Swenson Avenue and Flamingo Road by the Tropicana Wash. The lowest totals were in the far northwest where under a quarter of an inch fell in areas such as Centennial Hills.

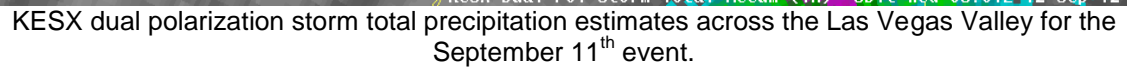
Storm total radar estimates from the Las Vegas WSR-88D radar were in fairly good agreement from both the legacy estimation and the new dual polarization estimates. The radar was switched by the staff at the National Weather Service in Las Vegas into a tropical Z-R relationship for this event due to the rather moist air mass in place across the area. Comparing totals from both the legacy and dual polarization estimates to ground measurements, both seemed to correlate estimate values very close to what was actually measured.



Las Vegas Valley rainfall totals from September 11, 2012 from automated weather stations operated by the Clark County Regional Flood Control District.



KESX legacy storm total precipitation estimates across the Las Vegas Valley for the September 11th event.



KESX dual polarization storm total precipitation estimates across the Las Vegas Valley for the September 11th event.

How Often Does Rain This Heavy Occur Historically?

Following is a table of rainfall totals for specific time intervals for McCarran International Airport. These values were obtained from climate record books on file at the National Weather Service through 1995 and then obtained from the values computed by the automated weather station which became the primary means of taking observations in September 1995. The values for September 11, 2012 rank among the greatest on record for 5 minute and 30 minute intervals. Using point precipitation estimates calculated specifically for McCarran International Airport and the 30 minute and 60 minute precipitation totals from , NOAA Precipitation Atlas 14, Precipitation Frequency, this was roughly a 25 year rainfall event for the McCarran Airport weather station.

Date	5 Minute	10 Minute	15 Minute	30 Minute	60 Minute
7/25/1954	0.39 inch	0.68 inch	0.87 inch	0.94 inch	0.94 inch
8/4/1955	0.39 inch	0.60 inch	0.74 inch	0.82 inch	0.82 inch
7/24/1956	Unavailable	0.40 inch	0.60 inch	0.93 inch	1.25 inches
8/21/1957	Unavailable	0.33 inch	0.46 inch	0.92 inch	1.36 inches
7/25/1976	0.30 inch	0.55 inch	0.70 inch	0.95 inch	1.15 inches
7/28/1984	0.30 inch	0.59 inch	0.86 inch	1.24 inches	1.29 inches
7/8/1999	Unavailable	Unavailable	Unavailable	0.76 inch	1.05 inches
8/22/2012	0.19 inch	0.34 inch	0.40 inch	0.51 inch	0.83 inch
9/11/2012	0.30 inch	0.47 inch	0.56 inch	0.82 inch	1.04 inches

Specific time interval precipitation totals for selected heavy rainfall events at McCarran International Airport since records started in 1937.

How Does This Flood Compare To Other Flash Floods?

Based on preliminary numbers with respect to the number of homes damaged and swiftwater rescues, the flash flood of September 11, 2012 falls just short of those reported during the August 19, 2003 flash flood that took place in the northwest part of Las Vegas. However, these numbers far exceed any on record for flash floods in the Las Vegas Valley since the flash flood of August 19, 2003. Although a numerical dollar estimate of damages from this flash flood are not yet available, it is reasonable to conclude this was the worst flash flood in the Las Vegas Valley in nearly 10 years based on the number of swiftwater rescues and homes damaged during this flash flood.

As shown in the previous table, rainfall totals in short duration time periods of 30 minutes or less from this event were as high as several previous events at the weather station at McCarran International Airport. Many of these other events did produce higher storm totals. However, the intensity of the rain in a period of 30 minutes or less with this event was a large factor in why flooding took place as quickly as it did. The rain just ran off quickly from where it fell.

Another large factor that resulted in flooding with this event was where the heaviest rain fell. This event produced heavy rain in several areas of the valley, including in the higher elevations of the west side which ultimately drains east. Additionally heavy rain fell in areas right along the Flamingo and Tropicana Washes which resulted in a rapid influx of water into both of these. In addition, as heavy rain fell over the central portion of the Las Vegas Valley, this combined with runoff from any rain that fell further west and helped to create rapid flows in washes and sent additional water toward the east side of the valley where the natural drainage flows ultimately. Therefore on the east side of the valley, flooding resulted from a combination of heavy rain that fell over this area plus additional water that ran down washes and the natural drainage system from the west.

Lastly, many areas that saw the heaviest rain are areas of the Las Vegas Valley where the flood control system is not as developed. In some areas, such as the Charleston Underpass, even though improvements were made, the intensity of the rain was likely greater than what the design was able to handle.



Flooding in the parking lot of UNLV. Photo courtesy: KLAS-TV/Las Vegas.



Las Vegas Wash one mile south of Vegas Valley Drive. Photo Courtesy: D. Stoltz.